University of Lethbridge

NEWS RELEASE

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New animal behaviour study lends insight to performance limits of Olympic athletes

As Olympians test the limits of their performance at the 2024 Paris Olympics, a University of Lethbridge animal behaviour researcher has co-authored a paper that is unlocking the way scientists can measure performance constraints — the factors that place limits on just how far and fast we can physically perform.

Dr. David Logue in ULethbridge's Department of Psychology and co-author Dr. Tyler Bonnell recently published the paper, *Skewed performance distributions as evidence of motor constraint in sports and animal displays*, in Royal Society Open Science. Logue, in his Birdsong Lab, studies birds to learn about the evolution of interactive communication. From songs to mating displays, he has travelled the world studying how birds communicate with one another and what factors influence their behaviours and ultimately lead to their successes or failures.

In seeking a better way to identify, characterize and compare performance constraints in animal behaviour, the two wondered if human sport was the perfect forum to test a new mathematical approach to quantifying whether a bird was really "trying" their best while performing their songs and what constraints might most influence their behaviour.

"We want to know for a certain behaviour if an animal is going up to their limit against a certain constraint, but we can't ask a bird if they are trying their best," says Logue. "So, we looked to high performance athletes to test our theory, because we know if we ask someone like Usain Bolt, for example, are you running as fast as you can, the answer will

be “yes”, and we believe him because he is motivated — by rewards like fame and money — to reach his limit.”

Their goal was to evaluate and expand the toolkit for the analysis of performance constraints. Having reviewed existing methods, they’d found that none were able to estimate constraints with data from one behavioural trait in one population. The math is fairly involved but in simple terms, they developed a formula that can be applied to multiple data sets that yields predictable results — in other words it works — showing that people, athletes and birds’ performances skew away from the constraint they are facing.

What is skew? Many distributions, like height or weight, are shaped like a bell curve, with a few extremes and most of the data showing somewhere in the middle. But when examining constrained performance (like running speed, or jump height), scientists don’t see a normal bell curve. Everyone is trying to perform at the highest level possible, but constraints, like limits to how fast their muscles can contract, prevent them from performing any higher. As such, values are bunched on the constrained side of the distribution. Statisticians call this a skewed distribution.

“It’s a statistical method to actually measure what the constraint is, like a signature of limitation, and then we’re able to use math to extract that and measure it,” explains Logue. “In science, we always need to measure stuff. So, this is a way of measuring things, and it's a particularly useful way of measuring because you only need to look at one variable.”

Logue says it was satisfying to apply their theory in numerous settings. They used data from Olympic athletes over multiple Games, testing it on throwing distances, jump distances and race times. They then applied it to baseball pitch speeds and even three-point shooting in basketball and each time, the math held up. And while he’s excited to now use it in the realm of evolutionary biology, they’ve opened the door to the approach having applications in multiple other domains, such as physiology and sport.

“Suppose that you wanted to test different training regimens with your athletes, or different nutrition regimens or different equipment. We could see if the constraint changes based on whether they wear these shoes or those shoes, whether they train like this or that. You could test multiple variables,” says Logue.

He says the next step for the study is to make it more accessible to those who might not be keen on the intricacies of the math needed to be applied.

“What we may be doing is writing a package for the programming language to where it’s more of a plug-and-play, off-the-shelf product you just apply to your data sets, as opposed to really having to understand the math and the hard-core coding end of it,” says Logue. “It’s exciting for me because we had this idea and now, we’ve shown it

works, which is great from an animal behaviour angle, and if it gets adopted by sports science, that would be killer because I love that area too."

To view online: https://www.ulethbridge.ca/unews/article/new-animal-behaviour-study-lends-insight-performance-limits-olympic-athletes

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